



NASA STTR 2015 Phase I Solicitation

T6 Human Health, Life Support and Habitation Systems

Lead Center: HQ

Human Health, Life Support and Habitation Systems, includes technologies necessary for supporting human health and survival during space exploration missions and consists of five technology subareas:

- Environmental control and life support systems and habitation systems.
- Extravehicular activity systems.
- Human health and performance.
- Environmental monitoring, safety, and emergency response.
- Radiation.

These missions can be short suborbital missions, extended microgravity missions, or missions to various destinations, and they experience what can generally be referred to as "extreme environments" including reduced gravity, high radiation and UV exposure, reduced pressures, and micrometeoroids and/or orbital debris.

Subtopics

T6.01 Gas Sensing Technology Advancements for Spacesuits

Lead Center: JSC

Space suit life support systems are critically necessary for the successful support of the International Space Station (ISS) and future human space exploration missions for in-space micro-gravity EVA and planetary surface operations. NASA has experienced a history of failures with the existing carbon dioxide (CO₂) gas sensor for the current Extravehicular Mobility Unit (EMU) due to excess moisture in the suit. In addition, NASA is presently developing an Advanced EMU (AEMU) for exploration missions. These missions will require a robust, lightweight, and maintainable Portable Life Support System (PLSS). The PLSS attaches to the space suit pressure garment and provides approximately an 8 hour supply of oxygen for breathing, suit pressurization, ventilation; humidity, trace- contaminant, carbon dioxide (CO₂) removal; and a thermal control system for crew member metabolic heat rejection. Innovative technologies and technology advancements are needed for the partial pressure gas sensors in the PLSS. Therefore, based on current and future EVA applications, advanced CO₂ gas sensing methods are needed that can tolerate ~100% oxygen, direct water contact (Relative Humidity 0-100%), 3-23.5 psia operating pressures, and CO₂ ranges of 0-30mmHg. Additional attributes needed include low mass and volume, low maintenance, and radiation hardened or radiation tolerant. Integration of other sensing capabilities such as ammonia (NH₃ 0-50 ppm) and oxygen (0-100%) is desirable.

T6.02 Space Weather

Lead Center: GSFC

Participating Center(s): JSC

Radiation hazards constitute one of the most serious risks to future human and robotic missions beyond Low-Earth Orbit, and particularly to long-duration, long-distance space missions. The main contributors to space radiation are Galactic Cosmic Rays (GCRs) and Solar Particle Events (SPEs). The latter is the more unpredictable of the two and is associated with most energetic solar eruptions: flares and coronal mass ejections; at the same time, SPEs are capable of inducing acute and profound effects on humans and on spacecraft components. Penetrating particle radiation from SPEs adversely affect aircraft avionics, communication and navigation, and potentially the health of airline crews and passengers on polar flights. SPEs also constitute major hazards for astronauts performing EVAs (Extra-Vehicular Activities) on board the International Space Station (ISS). Characterizing and predicting the dynamic variation of the radiation environment is a crucial capability, enabling personnel to take preventive measures to mitigate the potential risks, and facilitating adoption of the proper mitigation strategy. Many questions regarding space radiation have yet to be answered, and numerous challenges remain, such as improving the forecasting capability of the dynamic radiation environment (particularly SPEs), coupling the radiation environment models with engineering models of radiation effects on specific instruments or spacecraft hardware, and achieving a quantitative measure of human or space assets' response to radiation storms. The goal of the current opportunity is to help address the challenges by focusing on investigations that can potentially lead to longer-range (2-3 days) forecasting of SPEs (or at least an improved all-clear SPE forecasting capability), as well as those which couple radiation environment models with engineering models of radiation effects so that single-event effects on specific hardware and instruments can be predicted. Investigations that take an integrated approach, combining observation, theory and modeling, will be preferred. Those submitting proposals are urged to take advantage of relevant available observations (such as those from SDO, STEREOs, ACE, MAVEN, MSL/RAD, LRO, etc). The potential outcome will benefit all NASA missions, both robotic and manned, current and future. The goal is in line with NASA's Living with a Star Program (<http://lws.gsfc.nasa.gov>) and Human Research Roadmap (<http://humanresearchroadmap.nasa.gov/>).